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EDITORIAL

THE thirteenth meeting of the Geological Society of America, held in Albany, N. Y., was very satisfactory. The location was sufficiently central to insure a good attendance, the hotel accommodations were excellent and convenient to the place of meeting, and the number of papers was not more than could be read and discussed within the time of the meeting. The local committee, Dr. F. J. H. Merrill and Dr. J. M. Clarke, are to be congratulated on their hospitality and the success of their arrangements.

The postponement of President Dawson's address to the last day of the meeting was regretted by those who were unable to remain through the three days. It would seem advisable to have the presidential address delivered on the second day of the meeting, when there is the greatest number of members present.

The most notable feature of this meeting of the Geological Society, in the city that is looked upon as the cradle of American geology, was the conspicuous absence of a suitable monument to the memory of those pioneers of geological science who have opened a highway to stratigraphy through New York state, and have made of the state a corner stone of the geological structure of the whole country. Such a monument should take the form of a building in which not only the names and records of New York's venerated geologists may be inscribed and their collections preserved, but where their labors may be carried forward and from which inspiration and assistance may spread to geological workers throughout the state. In a state less than New York the absence of such a monument might pass unnoticed.

J. P. I.

THE second annual meeting of the Cordilleran section of the Geological Society of America was held on December 28 and 29. The morning session on the 28th took place in the council room of the California Academy of Sciences, in San Francisco. For the succeeding three sessions the members gathered in the rooms of the Geological Department of the University of California.

The following persons were present at the meeting of the section:

W. P. Blake, E. W. Claypole, A. S. Eakle, H. W. Fairbanks, E. W. Hilgard, W. C. Knight, A. C. Lawson, H. W. Turner, F. M. Anderson, W. C. Blasdale, F. C. Calkins, H. W. Furlong, O. H. Hershey, G. D. Louderback, C. F. Newcombe, W. J. Sinclair, J. C. Merriam.

At the first session Professor Wilbur C. Knight was elected chairman, Professor Andrew C. Lawson, secretary, and Dr. A. S. Eakle, councilor for the ensuing year.

In the course of the four sessions the following papers were read and discussed:

The Evidences of Shallow Seas in Paleozoic Time in Southern Arizona. By W. P. BLAKE, Tucson, Ariz.

In the mountain ranges of southern Arizona there is abundant evidence of shallow seas and shore lines in Paleozoic time. These shores were not, perhaps, a continental margin, but rather the borders of islands, crests of submerged mountain ranges rising at intervals above the Paleozoic ocean and with a trend or direction corresponding eventually to the direction of the mountain ranges of the region.

A cross-section of the territory northeasterly from the Gulf of California shows a succession of mountain ranges, some fifteen in number, in most of which ancient sandstones and conglomerates of Paleozoic age have been identified. Many of the exposures of quartzite are very thick, and these quartzites generally rest upon a coarse-grained porphyritic granite. Deep-sea deposits are not wanting. Thick beds of limestone, especially those of the Carboniferous, give evidence of depressed areas and of oscillations of level. So, also, the existence of thick, uplifted beds of graphitic coal in the Chiricahua Mountains bear testimony to the former existence of land areas, and show a far western extension of the vegetation of the Carboniferous.

Two localities of Devonian beds were described; one in the Santa Ritas and another at the northern end of the Santa Catalina Mountains.

The probable existence of Cambrian beds at several places was pointed out and the ancient tabular gneissic rocks of the Catalinas were referred to the Archean, and regarded as probable equivalents of the Huronian and Laurentian.

The Sierra Madre near Pasadena. By E. W. CLAYPOLE, Pasadena, Cal.

The paper opened with an expression of the surprise with which geologists who have worked principally in the East witness the enormous development and the excessive diastrophism exhibited by Tertiary and even by very late Tertiary strata in the West, and these characters are as well seen in California as in any other western state. The whole Tertiary period has apparently been signalized by thick accumulation, with alternate elevation and depression. Not less has its passage been characterized by volcanic outbursts of intense energy and by quiet outflows of lava almost unequaled in massiveness and extent.

Two great mountain ranges diverging in the north and meeting again in Kern county, inclose between them the San Joaquin Valley. This southern meeting forms one of the great natural features of the state — the Tehachapi Divide.

Speaking now only for the southern part of the state, there seems ample ground for the belief that these ranges have existed from at least Cretaceous if not from earlier Mesozoic time. It is not otherwise easy to find a source for the enormous Pliocene, Miocene and Eocene accumulations of the Pacific margin so far from the Sierra Nevada.

Thick gneissic strata of two types, and standing nearly vertical, compose the range of the Sierra Madre near Pasadena. That to the south contains a large proportion of hornblende, weathers rapidly and deeply, and is consequently eroded with comparative facility. That to the north is largely feldspathic, contains little hornblende, and of it consist the white crags that stand out so boldly on the upper slopes. The former of these masses cannot be less than 2000–3000 feet thick, but it does not rise in the mountain to a greater height than 3500 feet.

Of the wreckage from these two gneissic masses the material filling the valley of Pasadena is composed. From great bowlders near the foot of the Sierra it gradually diminishes till it becomes, in many places, a fine gravel and at last a fine silt. This last composes the adobe land around Los Angeles and also the many sheets of the same material which lie in the gravel, and are the holding-ground of the water supply. This has been so largely exploited during the two late dry seasons that the work has resulted in restoring confidence in the water resources of the valley, of which some had become rather doubtful.

The highly aluminous nature of many of these beds indicates a very extensive decay or kaolinization of the gneisses of the Sierra and together with the diluvial arrangement of the Pleistocene wash in the valley rather indicates a long continuance of the present climatic conditions than a past of greater and steadier rainfall.

The multiplication of wells has not yet shown any effect in lowering the water level unless perhaps in a few cases and this result is the more surprising and gratifying because it comes after two dry seasons in which only eleven inches of rain have fallen. Already this year, a greater total has been received than the above though the wet period has scarcely begun.

When to this is added the storage of the rainwater in tanks and ponds and the reforesting of the Sierras, wherever possible, it will be seen that the maintenance of the water supply in the future is encouraging.

Bates' Hole. By WILBUR C. KNIGHT, Laramie, Wyo.

Bates' Hole, a great natural depression, is located along the east and west boundary line between Carbon and Natrona counties, Wyoming; extending southward from six to ten miles into Carbon county and from twenty to twenty-five miles into Natrona county. The botbom of this depression is 800 feet below the rim near the head and over 1700 feet below it near the Platt River. The drainage is practically confined to Camp Creek which rises at the southern end of the Hole; but which affords water for only a portion of the year, and Bates Creek which rises in the Laramie Mountains and furnishes quite a stream. The country about this area is comparatively level; but to the eastward only a few miles rise the Laramie Mountains, and to the westward the Indian Grove and other ranges, which are made up of Mesozoic, Paleozoic, and Archean rocks. In length Bates' Hole varies from twenty-five to thirty-five miles and in width from six to twelve miles;

the lower end being much the wider. The dominant formation entering into the structure of this region is Tertiary; but this rests nearly horizontally upon a very uneven floor of older rocks, which in the central portion have been exposed and suffered extensive erosion. From the rim the slopes are very steep throughout, seldom being less than 15° to 20° and usually much higher and in many instances from 28° to 34°. Occasionally there are vertical walls of the Tertiary rocks from 100 to 200 feet, carved in the most unusual manner and often cut with deep, narrow, dry gorges. Capping the highest Tertiary escarpments there is a heavy conglomerate of unknown age; beneath this are the Titanotherium beds which have a thickness of about 600 feet, and in local depressions in the Cretaceous series underlying this region there is a third series of Tertiary beds, composed of variegated clays and sands that is in all probability Eocene. Along the Platte River all of the Tertiary rocks have been removed and along the Laramie Mountains there are exposed in natural order, Cretaceous, Jurassic, Triassic, Carboniferous, Cambrian, and Archean as one ascends the range. Along the Tertiary escarpments are numerous stunted pines (*Pinus flexlis*) whose roots are exposed from one to eight feet which signifies very rapid erosion. This erosion has been very general and data that will aid us in determining the age of Bates' Hole are well in hand. Illustrated with lantern slides.

A Geological Section through the John Day Basin. By JOHN C. MERRIAM, Berkeley, Cal.

The John Day River and its tributaries have exposed in the erosion of their canyons about ten thousand feet of strata, giving a full series of formations from Lower Cretaceous to Quaternary.

The oldest rocks in this region, which are known to the writer, are a series of altered sedimentaries in the northeastern part of the basin. They are pretty certainly of pre-Cretaceous age and are underlain by quartz diorite[1] which is presumably intruded into them.

On Bridge Creek, near Mitchell, a great thickness of Cretaceous is exposed. The lower 2000 to 3000 feet of this section are typical Knoxville. The upper 1000 to 2000 feet are Chico.

Resting upon the Chico, near Mitchell, also showing typical exposures at Clarno's Ferry, is a presumably Eocene formation to which the name Clarno is given. This formation is made up entirely of tuffs, ashes, and lavas. In places it contains many plant remains and is apparently in part a fresh water formation.

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[1] Determined by Frank C. Calkins.

The John Day formation rests directly upon the Clarno at Clarno's Ferry. The basin in which it was deposited is quite different from that of the Clarno. It probably rests unconformably upon that formation. The Lower John Day beds are considerably contorted in some localities. Ordinarily they are colored a deep red. Fossil remains are exceedingly rare in this division.

The blue-green beds of the Middle John Day are very fossiliferous. They correspond to the Diceratherium beds of Wortman. The Upper or Buff beds of the John Day lap over the middle division and rest in places upon the older formations. The upper division corresponds to the Merycochœrus Beds of Wortman. As *Merycochœrus* does not occur in the John Day, the upper division will be called the Paracotylops Beds. This name is based on the new generic name proposed by W. D. Matthew for the Upper John Day oreodons, originally supposed to be *Merycochœrus*.

The Columbia lava, an extension of the lavas on the Columbia River to the north, rests unconformably upon the crumpled John Day formation. The name Columbia lava should be restricted to this horizon of the lavas in this region, as other beds included in this group belong in some cases to different geological periods.

The Cottonwood (Loup Fork) formation, near 1000 feet in thickness, rests upon the Columbia lava. The Van Horn Ranch plants, which have generally been considered as John Day, are from this horizon. Remains of a true John Day flora, which had not previously been known, were discovered by the University of California expedition in 1900. The discovery of the true stratigraphic position of the Van Horn Ranch flora explains the apparent inverted position of the Neocene formations in central Washington.

Resting on the worn edges of the Cottonwood Beds is the Rattlesnake formation, comprising several hundred feet of gravel, tuff, and lava.

In canyons cut through the Rattlesnake and Cottonwood are several terraces. Remains of elephants and later horses found in the lower terrace deposits show that they were formed in Quaternary time.

The paper was illustrated with lantern slides showing the principal formations and their relations to each other.

The Geology of the Great Basin in Eastern California and Southwestern Nevada. By H. W. Turner, San Francisco, Cal.

The ridges of the western edge of the Great Basin in Nevada and eastern California are usually very complex in structure and composition. They comprise sediments of Paleozoic and Jura-Trias age much disturbed at some points by intrusions of granolites. In Tertiary time there were extensive lakes, and contemporaneous with these lakes and also later are lavas and tuffs in large amounts, chiefly rhyolites, andesites, and basalts.

The formation of the ranges, or at least their latest uplifts, date from the late Tertiary and post-Tertiary time.

They were elevated along normal faults, the valleys being in part subsided areas, often of the nature of rock basins, whose rims are composed of rocks older than the desert detritus.

There are some gneisses pretty certainly of pre-Cambrian age. These gneisses underlie Lower Cambrian sediments rich in fossil remains at some points. There is an extensive chert series containig abundant graptolites supposed to be of Lower Silurian age. There are Lower Trias beds in the Inyo Range and Jurassic limestone in the Pilot Mountains.

The Tertiary lake beds contain abundant plant, molluscan, and fish remains.

The paper was illustrated with lantern slides.

Notes on the Geology of the Three Sisters, Oregon. By H. W. Fairbanks, Berkeley, Cal.

The Three Sisters form a group of volcanic peaks upon the summit of the Cascade Range in central Oregon. They rise to a height of about ten thousand feet, and are quite similar in many respects to the other great volcanic peaks which mark the crest of the Cascade Range through Oregon and Washington.

This group of peaks is marked by the presence of a glacier nearly three miles long and half a mile wide.

To the north of the peaks recent volcanic activity is indicated by extensive flows of basic lavas. Volcanic eruptions have occurred since the glacial period, as shown by the relation of the lavas to the grooved and polished surfaces. A volcanic cone upon the North Sister lies in the path of the present glacier.

Illustrated by lantern slides.

A Sketch of the Pedological Geology of California. By E. W. HILGARD, Berkeley, Cal.

Owing to the great climatic diversity, the rainfall varying from two inches at the south to as much as eighty inches in the north, even a sketch of the soil conditions of California must take the climates into consideration. The cardinal difference between rock decomposition in arid as compared with humid climates lies in the retardation of kaolinization, as exemplified in the monoliths of Egypt and the granites of the Sierra Madre, as compared, *e. g.*, with the Alleghanies. Hence in northern California and on the higher Sierra Nevada we find loams and clay soils, while at the lower levels and in southern California the soils are "dusty" or sandy, except where derived from preëxisting clay formations, which give rise to "adobe," and in the upper valleys of the rivers of the Sierra, which carry the materials from the higher levels.

Throughout the middle and southern parts of the state, where no rains of consequence fall between May and November, not only is the soil mass usually of extraordinary depth, but is scarcely changed for several, sometimes for four to ten, feet. There is practically no subsoil in the usual sense, in the absence of clay; water, roots, and air penetrate together to depths impossible in the regions of summer rains, and hence the extraordinary endurance of drought, even by plants foreign to the arid region. Moreover, these soils almost universally contain high percentages of lime and potash, due to the absence of the leaching process, which, on the other hand, results in the formation of "alkali soils," too complex a subject to be dealt with here.

"*Sand*" in the arid soils is not merely quartz grains, but consists of all the original minerals, superficially decomposed. Hence sandy lands are here fully as rich as clay lands are elsewhere.

In the Great Valley it is easy to recognize by their microscopic characters the alluvial areas of the several rivers coming in from the Sierra. Even here the greater rainfall of the Sacramento is evidenced by loam and clay lands, as compared with the San Joaquin valley, where sandy and silty lands prevail altogether. As the rainfall decreases toward the Coast Ranges, the "lightest" are found under the arid lee on the west border of the valley. In its axis, in the "tule lands," as well as on the borders of the bays near its outlet, heavy clay soils are being formed in the slack water, while the streams coming from the Coast Ranges are bordered by light silty lands, the "truck lands" from which San Francisco markets are supplied. Along the foothills of the Sierra there lies a belt of varying width of heavy red clay lands, probably derived from Ione formation, and frequently closely packed with gravel. These materials are intrinsically poor in plant food and being difficultly penetrable by roots, have caused much disappointment to settlers, and were the first to be treated by the energetic method of blasting with dynamite for fruit culture. They improve materially toward the south and in Fresno county form the basis for successful citrus culture. Higher up in the foothills come the characteristic red soils, the gold-bearing earths, mostly derived from the older slates and sedentary thereon. They are interpersed with patches of gray "granite" lands, which are very much less productive, being derived from the granodiorites, deficient in potash and phosphoric acid.

The soils of the Coast Ranges vary greatly, with their varying rock formations, among which are much clay and clay shale, forming correspondingly heavy soils. But the valleys also are filled with deep silty or sandy deposits. Southward the Coast Ranges are continued in the Sierra Madre, which forms the northern wall of the valley of southern California.

This valley, now subdivided into the drainage basins of the Santa Ana and San Gabriel, was undoubtedly originally a unit. This is proved by a terrace of "red lands," which extends all around from Redlands and Riverside to Los Angeles. Its subdivision was effected in late times by the great débris cone of the San Antonio Creek, which abutting against the Puente hills cut the drainage in two. The red soils are the special ones for citrus culture; but the sandy and silty alluvium of the two rivers also serves the same purpose.

The Neocene Basins of the Klamath Mountains. By F. M. ANDERSON, Berkeley, Cal. Presented by Andrew C. Lawson.

This paper is an attempt to show some of the more salient structural features of the Klamath Mountains, including not only their basins, but also their principal ranges. The three chief ranges of the group, extending in a northeasterly direction from the coast, and the drainage basins intervening and otherwise associated, form the main subject of discussion. Of the two systems of ranges crossing each other nearly at right angles, the northeast and southwest ranges are the older, and have exerted a controlling influence over the drainage since their beginning. The principal rivers of the region — the Rogue River, the Klamath, and the Trinity — cut transversely across the more nearly north and south ranges, showing them to be younger in age than the lines of drainage followed by these streams, and accordingly younger in age than the east and west ranges.

The historical development of these drainage basins is shown by the deposits contained in them, and for some of them it antedates the later Cretaceous epochs at least. The earliest drainage of the basin of the Klamath lakes is shown to have been through the valley of Rogue River, and to have been diverted from that course to its present, by some of the later lava flows from the Cascades. Evidence is cited to show that during the Chico epoch this basin was not connected with that of the Pitt River or the Sacramento, and it is maintained that its individuality has been kept almost unchanged to the present. As one of the larger streams of the region therefore, the Klamath is younger in age than either the Trinity or Rogue River.

On the Age of Certain Granites in the Klamath Mountains. By OSCAR H. HERSHEY, Berkeley, Cal. Presented by A. C. LAWSON.

Small batholites and dikes of granite, quartz-mica-diorite and intermediate types are shown to occur at various places in the Klamath region, but in areas quite subordinate in extent to those of the metamorphic rocks into which they have been intruded. The same contains extensive areas of serpentine and instances are given of the granitic rocks having been intruded into the serpentine to prove that the granites are newer, in accordance with the determined relations of these rock types in the Sierra Nevada region, and the reverse of the supposed relation between the granite and the serpentine of the Coast Ranges.

The black slates of the Klamath region are divided into two distinct series, referred to as the Lower Slates and the Upper Slates. The former are considered Devono-Carboniferous in age, being in part equivalent to the Calaveras formation. The latter are correlated, on the evidence of their lithology and of their structural relations to the Lower Slates and to a certain extrusive greenstone formation similar to the diabase and porphyrite formation of the Sierra Nevada region, with the Mariposa formation of late Jurassic age. The intrusion of granite occurred later than the deposition of these Upper Slates. Also it is shown that the granites are much older than the Chico formation resting on them as they had suffered much erosion prior to the Chico epoch.

It is finally concluded that the weight of evidence places the granitic intrusion just about at the close of the Jurassic period. The effect of the argument is to show that there is a sound basis for the inference heretofore entertained that the Klamath Mountains belong rather to the Sierra Nevada system than to the Coast Ranges and may be considered a sort of outlier to the former.

The Drainage Features of California. By ANDREW C. LAWSON, Berkeley, Cal.

A comparative study of the geomorphy of the Sierra Nevada and the Coast Ranges. There is a remarkable contrast in the character of the river valleys in the two mountain systems, those of the Sierra Nevada being consequent and the geomorphy immature, while those of the Coast Ranges are subsequent and the geomorphy mature. In the Coast Ranges the geomorphic profiles of the river valleys, leaving out of consideration the head-water streams, are not so steep as in the Sierra Nevada, and the valleys are much wider as a general rule. The divides are rounded or ridge like, with but small remnants of the earlier geomorphic cycle identifiable, in the Coast Ranges, while in a large part of the Sierra Nevada the divides have a marked table or plateau form. The drainage of the Coast Ranges is clearly controlled by the structure of the country while the streams of the Sierra Nevada cut *across* the strike of the rocks, and have made but little headway in the working out of canyons *along* the strike of the softer formations.

The Klamath River is regarded by the author as partly having the consequent character of the Sierra Nevada drainage and partly the character of the Coast Range drainage. The Trinity River and its prolongation in the lower Klamath belongs to the Coast Range system being parallel to the strike of the country and in part mature in its development, while the upper Klamath is consequent and young. This affords us a basis for the separation of the Klamath Mountains from the Coast Ranges, and supports the orogenic correlation of the Klamath Mountains with the Sierra Nevada. The comparison thus made points clearly to the conclusion that the Sierra Nevada and probably also the Klamath Mountains are of later date than the emergence of the Coast Ranges which inaugurated the present cycle of geomorphic evolution. But the subsequent valleys of the Coast Ranges are in several instances known to have been evolved after the deformation of the Pliocene, and we are thus forced to place a very late geological date upon the tilting of the Sierra Nevada orographic block.

A Feldspar-Corundum Rock from Plumas County, California. By ANDREW C. CLAWSON, Berkeley, Cal.

Mr. Turner, of the United States geological survey, has called attention to the prevalence of feldspathic "albitic" dykes cutting serpentine in various parts of the Sierra Nevada. The rock of which the present paper treats apparently belongs to this series of dykes. It occurs as a white coarse-grained dyke cutting the serpentine of the eastern flank of Spanish Peak, Plumas county. The rock is composed of 84 per cent. of oligoclase and 16 per cent. of corundum in crystals up to over two inches in length, and rather irregularly distributed through the feldspathic groundmass.

The following is an analysis of the feldspar:

SiO_2, 61.36; Al_2O_3, 22.97; Na_2O, 8.08; CaO, 5.38; H_2O, 1.72. Total, 99.51; Sp. g, 2.63.

The occurrence is of special interest as one of the rare cases of a rock supersaturated with alumina, and its occurrence as a dyke in a rock devoid of alumina, soda, and lime is of especial interest as supporting a case of extreme differentiation of rock magma.

The foregoing synopses were prepared by the authors of the papers.

JOHN C. MERRIAM.